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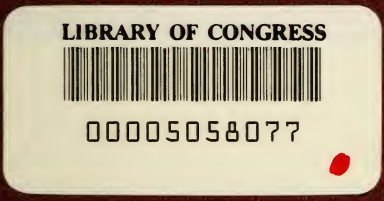

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Star-Gazer's Hand-Book

A BRIEF GUIDE FOR

Amateur Students of Astronomy

BY

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Philadelphia

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PREFACE

In presenting the subject of Astronomy at Teachers' Institutes and similar gatherings, I have frequently been requested to recommend a handbook for ready reference by which one pursuing the subject without a teacher might not only learn the general facts of Astronomy, but also trace out the constellations and learn the mythological stories in connection with them. I know of several excellent books on the subject, but none containing this last-named feature—and I decided to write one. I stated this fact to a Teachers' Institute (in Montgomery Co., Pa.), and stated also that, owing to other work in hand, I could not do this within a year, whereupon the teachers to the number of three hundred and forty-two sent in their names as advance subscribers, if I would prepare the book immediately. This request could not be ignored, and hence this booklet is issued a year sooner than intended by the writer.

In the first part I have given in a form as condensed as possible, the main astronomical facts according to the latest discoveries, but have made no pretense of entering into higher mathematical Astronomy. Those wishing to become specialists in the subject cannot confine themselves to this little book.

In the second part, which treats of the Constellations, I have omitted all that are visible only in the southern hemisphere, and a few unimportant ones in the north, especially those of modern in-

vention. In giving the names of the stars I have used only the names given by the ancients, as these are far more poetic and attractive than the names of the Greek Alphabet, as used generally by astronomers. This modern method of naming the stars is necessary to astronomers, but not to those who desire to remember the names of only a few of the brightest stars in each constellation.

H. W. E.

Philadelphia, Pa.,
January, 1902.

Astronomy.—The study of Astronomy is one of the most delightful and soul-inspiring of all studies. It lifts the soul above earthly things and leads one to contemplate the immensity of the Universe. "We love to look at a star," said Victor Hugo, "for two reasons—because it is bright and because it is impenetrable." "Two things fill me with unceasing awe," said the great German philosopher, Kant, "the starry heavens above and the moral law within."

The history and the destiny of the heavenly bodies we cannot know in this life, but we may know something of their immense distances from us and from one another, and of the laws that govern them in their sublime, silent revolutions through eternal space. As we gaze into the deep, measureless heavens and note the suns and worlds in their unceasing motions through the boundless depths of space, we feel as at no other time the meaning of the Psalmist's words, "Great and marvelous are thy works, Lord God Almighty."

We may divide the *Universe* into three parts:

First, the EARTH—the great globe on which we live, turning on its axis once in twenty-four hours, speeding around the sun at the rate of nineteen miles per second, and so poised in its course as not to fall into the sun, nor to fly away into space. *Second*, the SOLAR SYSTEM—the Sun, a great ball of fire in the sky, and his family of planets, eight large dark bodies, including the earth; and many smaller ones, all revolving around the sun in the same direction (from west to east) within a belt of the sky called the Zodiac, 16° in width. *Third*, the SIDEREAL HEAVENS—the vast, unmeasured space beyond our system in which are all the fixed stars.

STAR GAZER'S HAND-BOOK

CHAPTER I

THE SOLAR SYSTEM

The Sun.—The most glorious object ever beheld by human eyes is the sun. The sun is a globe of fire, in a molten state, and it radiates light and heat in all directions. A portion of this light and heat reaches us, and without it there could be no life upon the earth. The heat of the sun is so great that any substance known to us, if thrown into that cauldron, would instantly be reduced to vapor. The diameter of the sun is 866,400 miles, and if he were a hollow globe and the earth were placed at his center, the moon could still hold her course in her orbit, and there would yet be nearly 200,000 miles beyond the moon's orbit to the surface of the sun's shell. The volume of the sun is 1,300,000 times that of the earth. The density of the sun, however, is but one-fourth that of the earth, and his actual mass but 330,000 times the mass of the earth, and 750 times the mass or weight of all the planets combined.

The visible surface of the sun, called the photosphere, is composed of white-hot gaseous and semi-liquid matter, which, in its furious boiling, throws out jets reaching to the height of 60,000 miles. The heat is supposed to be generated by a contraction of the sun upon itself, at the rate of about six feet per century. If this be true, the time must come, many million years hence, when the process can go on no longer and the sun will

become a dark and cold body. The sun revolves on his axis in twenty-five and one-fourth days. He holds the planets in their orbits by the great Newtonion law of gravitation by which every body in the universe attracts every other body in proportion directly to the mass of each and inversely to the square of the distance between them.

So great is the sun's attraction that a man of ordinary size would weigh, on its surface, twenty-seven times as much as on the earth's surface, or about five thousand pounds, and he would be crushed to death by his own weight. Great dark spots are often seen on the sun's surface, and if greater than 27,000 miles in diameter, they can be seen with the naked eye. In 1858 there was one 150,000 miles in diameter. The sun is surrounded by an atmosphere without which his rays would be twice as hot as they are and would be bluish in color.

One of the most momentous of modern astronomical discoveries is that the sun, with all his family of planets, is moving through space at the rate of about twelve miles per second, toward the constellation Lyra; but how great may be this revolution or how many thousands of years may be required to make it we have no knowledge.

The Earth.—The age and origin of the earth are utterly unknown to us. While a firm believer in the Bible, I can readily accept the theory that the days of creation mentioned in Genesis were days, not of twenty-four hours each, but of long periods of time, aggregating perhaps millions of years. According to the Nebular Hypothesis the earth, as well as the other planets, was originally a part of the sun, and in the remote past was sloughed off into space, and in the course of ages

its heat was radiated into space until its surface became cold and solid, and it became the home of plants and animals and men. The earth revolves around the sun in a fixed path called its orbit.

The orbit of the earth is an ellipse, and the earth is some three million miles nearer the sun in January than in July. Here then arise two questions that must be answered with some care: Why does not the earth fall into the sun? and why does it not fly away into space? The earth is acted on by two powerful forces, the attraction of the sun, which tends to draw it toward that body; and the tendency to fly away, as a drop of water on the rim of a revolving wheel tends to fly away from the wheel. To answer the first question, let us begin with July, when the earth is at *aphelion*, farthest from the sun. For five months after this time the earth is approaching the sun and the sun's attraction increases its speed until, in December, it is flying considerably faster than in July. The tendency, therefore, of the earth to fall into the sun is counteracted by the increased speed of the former, which increases its tendency to fly away from the sun, as the drop of water tends to leave the wheel when the motion of the latter is increased.

The earth, therefore, swings around nearer the sun in January, and its increased speed causes it to again recede from the sun. This receding continues for five months. Why then does not the earth continue its flight until the sun's attraction is overcome? Because the motion of the earth is now retarded during these five months by the continued attraction of the sun, which tends to draw the earth back again. At length the power of the sun gains the mastery and the earth swings around

in July and again approaches the sun. Thus the earth is perfectly poised between these two mighty forces, and so it flies in its orbit on and on forever. If, however, the earth's speed reached twenty-six miles or more per second, instead of nineteen, the sun's power could not hold it and it would fly away into the region of darkness, and so distant are the stars that it would not reach the nearest of them for many thousands of years.

The Moon.—The larger planets all have moons or satellites. One of them has eight moons. The earth has one. Our moon is a dark, cold body. Half of the moon, when not eclipsed, is always lighted by the sun. If the entire lighted surface is turned toward us, we see the full moon; if half of it, we see a half moon; if one-fourth of it, we see the first quarter or the last quarter. These are known as the moon's phases.*

The moon's mean distance from the earth is 240,000 miles. It is 2160 miles in diameter, the surface being about one-fourteenth the surface of the earth, or four and a half times that of the United States. Weight on the moon is about one-sixth that on the earth's surface, and a man of ordinary size would weigh some twenty-five pounds on the moon, and with ordinary strength he could jump sixty or seventy feet, or throw a ball half a mile.

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* When the moon is full she is always opposite the sun in the heavens. If you see a full moon on the meridian, *i. e.*, directly south of the zenith, it is midnight. A full moon in the morning must be in the west; in the evening, it must be in the east. A half moon on the meridian indicates evening, if the light side is turned toward the west; if toward the east, it is morning before sunrise.

The moon turns on her axis once with each revolution around the earth—twenty-nine and a half days. The same side of the moon is therefore always turned toward us and no human being ever saw the other side; but owing to her librations we can see about four-sevenths of the surface. We see the reflected sunlight from the otherwise dark surface of the moon; and if one could view the earth from the moon he would see a large bright globe, four times as great in diameter as our moon, which would show the same phases, full earth, half earth, first quarter, last quarter, etc. When the new moon appears in the west, the entire body can be seen in dim outline. This is caused by a full earth.

The moon is without an atmosphere, and as atmosphere is essential to life and sound, there is no life and no sound on our satellite. The imagination cannot picture a more lonely and dreary waste than is the surface of the moon. The surface is marvelously rugged and mountainous. There are about three thousand extinct volcanoes visible through the telescope, and the highest mountain peaks probably exceed in height any upon the earth. There is no water on the moon, but there may be ice in the deep places and where the sun does not shine the temperature is doubtless 300 degrees below zero, Fahrenheit.

Eclipses.—When the moon comes directly between the sun and the earth, the sun is eclipsed. It happens that the diameter of the sun is four hundred times that of the moon, and he is four hundred times farther from us than the moon, and hence they seem to be about the same size—half a degree in diameter. From this fact the

moon crossing the sun's disc is just large enough to cover it and produce a total eclipse. If, however, the moon is in apogee, at her farthest point from the earth (for her orbit is an ellipse and her distance from the earth varies a few thousand miles), she is not large enough to cover the entire surface of the sun, and a little rim of light is seen all around her. This is called an annular eclipse, from the Latin *annulus*, a ring. A total eclipse can occur only when the moon is in perigee, *i. e.*, nearest the earth. A partial eclipse occurs when the moon does not squarely cross the face of the sun, but covers only part of it. The deep shadow of a total eclipse is called the umbra; the partial shadow, the pen-umbra, from the Latin words *pene*, almost, and *umbra* a shadow. A total eclipse of the sun is one of the grandest scenes in nature, as it reveals the sun's corona, a beautiful crown of light which cannot be seen at any other time. But its occurrence is rare at any one place because the moon's shadow is narrow—not over a hundred miles in width.

The next total solar eclipse in the United States will be on June 8, 1918, and it will sweep from Oregon to Florida. The longest duration of a total eclipse of the sun is a little over seven minutes, but there has been none of that length for a thousand years. The next will occur in India in 1955.

There must be at least two solar eclipses (not necessarily total) every year, and there may be five—never more than five—and this only when the first comes in January. A solar eclipse occurs when the moon crosses the ecliptic, *i. e.*, the sun's apparent path in the heavens. If the moon's orbit were in the same plane as the earth's orbit,

there would be a solar eclipse every month, but the plane of the earth's orbit and the plane of the moon's orbit are inclined five and one-seventh degrees. The moon crosses the ecliptic every six months (or twenty days less owing to the procession of the equinoxes) and at each crossing there must be a solar eclipse. But since the sun requires thirty-seven days to pass the moon's node, and the moon's revolution around the earth is made in twenty-nine and one-half days, there may be two partial solar eclipses at one passing of the node.

An eclipse of the moon occurs only at full moon, and then only when near her node, or the crossing of the ecliptic. It is always about fifteen days before or after an eclipse of the sun.

The shadow of the earth is a cone in form. It extends into space opposite the sun for 857,000 miles, where it tapers to a point. If the sun and earth were of equal size, this shadow would be a cylinder, and would extend indefinitely into space. It might then eclipse a planet or any body receiving its light from the sun, but never the fixed stars, because they shine by their own light. As it is, this shadow can eclipse the moon only, as it is the only heavenly body within 857,000 miles of the earth.

The diameter of the base of this cone-shadow is co-equal with the earth's diameter, 8000 miles, and at the moon's distance, 240,000 miles, it is yet nearly 6000 miles in diameter. The moon is but 2160 miles in diameter, and she can therefore easily be totally eclipsed by the earth's shadow. A total lunar eclipse may continue for several hours, not only because the shadow is so much broader than the moon, but also because she

is sweeping through the sky in the same direction as the shadow.

The Planets.—The planets, or "wanderers," are the heavenly bodies that revolve forever about the sun, tethered by his powerful attraction, all moving with marvelous harmony in fixed elliptical orbits. The eight great planets in the order

	Mean Dis. from Sun, Million Miles	Revolution around Sun	Rotation on Axis	Diameter, Miles	Color	Number of Moons
MERCURY,	36	88 days	88 days	3,000	Pale Ash	0
VENUS, . .	67	225 "	225 "	7,700	Bright Straw	0
EARTH, . .	93	365 "	24 hours	7,920		1
MARS, . . .	141	687 "	24 "	4,200	Reddish Ochre	2
JUPITER, .	483	12 yrs.	10 hrs. 10 min.	87,000	Silver	5
SATURN, .	886	30 "	10 " 12 "	71,000	Dull Yellow	8
URANUS, .	1780	84 "	10 "	31,700	Pale Green	4
NEPTUNE,	2790	165 "	Unknown	34,500	Pale Green	1

NOTE.—Round numbers are usually given in the above table because more easily remembered. Neptune, since its discovery in 1846, has been considered as marking the remotest boundary of the solar system; but on account of disturbances in the orbits of comets and other bodies, some leading astronomers have come to believe that there is yet an undiscovered planet three times as far from the sun as that planet. It is further believed that this planet is the largest of them all and requires a thousand years to make a revolution around the sun. The nearer a planet is to the sun the greater his attraction; but this is counteracted by its swifter motion.

of their distance from the sun are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. Besides these there are many small ones between the orbits of Mars and Jupiter. Mercury and Venus are often called inferior planets, because nearer the sun than the earth, while those farther from the sun than the earth are called superior planets. Again, Mercury, Venus, Earth, and Mars are called terrestrial planets and the other four the outer planets. The four outer planets are much larger than the terrestrial planets. To show size, distance from the sun, rotation, etc., in condensed form for ready reference, the foregoing table is given.

Jupiter is known as the giant planet. His volume is greater than that of all the other planets together—more than 1200 times the size of the earth. Saturn comes next and is larger than all the rest combined, excluding Jupiter. In regard to size the planets are divided into four pairs. Jupiter and Saturn constitute the first pair, their respective diameters being each above 70,000 miles. The second pair are Uranus and Neptune, with diameters above 30,000 miles. The earth and Venus, each with a diameter a little less than 8000 miles, constitute the third pair, while the smallest of the planets are Mars and Mercury. The planets nearest the earth go through the same phases as the moon, but these changes cannot be seen without optical aid.

Visibility.—Two of the planets, Mercury and Venus, are nearer the sun than we are and can never be seen opposite the sun in the sky, nor even on the meridian. Mercury is visible at certain seasons, hovering near the sun in the evening

just after dark or in the morning before sunrise—never more than 18° from the sun. Venus may be seen as high as 47° from the sun, morning or evening.* She is the most brilliant object in the heavens except the sun and moon. The planets are all non-luminous and shine by reflected light from the sun. Mars when on the same side of the sun with the earth may come within 36,000,000 miles of the latter and at such times he is a very bright and beautiful object; but when opposite the earth he is about seven times as far away as when nearest. Jupiter is, next to Venus, the brightest of the planets, while Saturn, which is surrounded by a vast circle of rings, probably of a gaseous nature, shines like an ordinary first magnitude star. Uranus seems like a star of the sixth magnitude, and is seldom seen by the naked eye, while Neptune is never visible except through the telescope. Two or three of the planets are visible at some hour of almost any clear night. They are never seen in the zenith or north of it, nor low in the southern horizon, but always within the belt of the zodiac—the path of the sun and moon. To find them, consult an almanac. Once found, they are not hard to keep track of.

Are the Planets inhabited? — This question has been widely discussed, but all opinions on the subject are mere conjecture. With some of the planets, however, a negative answer seems conclusive. Mercury and Venus have the same side always turned toward the sun. On these planets the sun never rises and never sets. On

*Any good almanac will tell when Venus or Mercury is morning or evening star.

the one side of each is perpetual day and perpetual summer (much hotter than our own), while the opposite side is enveloped in eternal darkness. Such creatures as ourselves could scarcely exist on either of these globes, except it would be around the belt of twilight, and this is not at all probable.

The two outer planets of the Solar system, Uranus and Neptune, from which the sun would seem only like a brilliant star, receive so little light and heat from the orb of day that it would seem impossible that such beings as we are could exist there. There is no known reason, however, why some form of animal life should not be found on these planets. Of Jupiter and Saturn we may say that it is almost certain that no life exists on these vast globes. The reason is not far to seek. Astronomers generally agree that they are not yet fully cold, are possibly in a semi-molten state; though their heat is so far gone that they are no longer self-luminous.

This leaves us Mars alone, the most interesting of all the planets aside from our own. The aspects of this planet seem to present all the conditions necessary to sustain life. The light and heat from the sun, while much less than received by us, are quite sufficient to sustain life. Air and water seem to be present, and so every condition of animal and vegetable life. But we have no positive knowledge on the subject. The most powerful telescopes reveal certain markings that seem like canals and variable polar caps that look like ice or snow; but they tell us nothing further. Mars is probably inhabited; but we have no means of proving that it is.

The general belief that there are other worlds in

our solar system or in other systems which are inhabited by intelligent beings cannot be proved, but the opposite belief is narrow and untenable. Our earth is but a tiny speck in comparison with the universe. How can one believe that an all-wise Creator would people this one little ball with creatures after His own image and leave all the rest of creation a lifeless waste? Would a farmer who owned a thousand acres of land be content with raising one ear of corn, or one hill of potatoes? The Creator has told us only a little about Himself in the Bible. We cannot conceive of Him as limited in power, or of an end to space, or of a beginning or an end of time.

Some heavenly bodies are far gone in their life history and the conditions of animal life are no longer present; others seem to be in process of formation. It is most reasonable to believe that the one may have been the home of life in the past and that the other may be so in the future. If other worlds are inhabited, such inhabitants may be creatures similar to ourselves; but we do not know.

CHAPTER II

COMETS AND METEORS

Comets.—From ancient times comets have been regarded with much superstition; but modern astronomers have discovered that comets travel through space in accordance with fixed laws, and are as harmless as other heavenly bodies.

A comet is composed of three parts, 1, the nucleus, the star-like point; 2, the coma, or hair surrounding the nucleus, and 3, the tail. The nucleus and coma are together called the head. The nucleus of a comet is probably solid matter, but is very small as compared with the smallest of the major planets; the coma is vaporous, while the tail, often many million miles in length, is immeasurably thinner and lighter than the air we breathe. Comets are drawn from the depths of space by the sun's power; they sweep around the sun with great velocity and then flee away again into unknown regions. In the preceding chapter it was explained how the earth, while approaching the sun from July to December, increases in speed, and how this greater velocity increases the centrifugal power and causes it to fly away again. The same is true in a far greater degree in the case of comets. For years they are approaching the sun and their speed increasing until, when they rush round that orb, it is sometimes with the frightful velocity of a million miles an hour. This speed was reached by the great comet of 1843, which was visible in daylight. It

swept within 50,000 miles of the sun's disc, almost grazing his glowing surface, and then sped away into space to return no more for five hundred years.

Most comets belong permanently to the solar system. They travel in very eccentric ellipses and return at regular periods, three years or more. Some fly beyond the orbit of Neptune and more than a century is often required for a revolution. Other comets visit our system once and sink away again into the unknown depths of the skies never to return. If a comet's velocity at ninety million miles from the sun exceeds twenty-six miles a second, the sun has no power to hold it and it flies away to be seen no more. Sometimes, however, a comet of this class comes so near to Jupiter, or some other great planet, that its course is disturbed by his attraction, its velocity lessened, and it becomes a permanent member of the solar system. Jupiter is known to have caught eighteen comets in this net, while Saturn, Uranus, and Neptune each have a few. The reason why comets do not seriously disturb the planets in their orbits is that the former are so small that their attractive power is not greatly felt.

Sometimes a comet in passing very near the sun is torn to pieces by his enormous attraction. The fragments then continue separately in the same path as before. This occurred with the lost Biela's comet in 1846, and with others since then. At each return to perihelion the fragments are further disintegrated until they are divided into millions of meteoric particles, and these still continue in the orbit of the original comet.

No other appearance in the skies has excited such consternation through many ages as the

approach of comets. But there is little to fear. The tail of a comet is so thin that it could do us no harm. In 1861 the earth passed through a comet's tail with no ill effects. The coma, however, if it reached our orb would doubtless vitiate our atmosphere and cause serious damage, but such a contact is not at all likely to happen. But if the nucleus of a large comet were to strike the earth squarely, it would no doubt generate great heat and destroy all life upon our globe. It has been calculated, however, that the chances are that a comet will not strike the earth oftener than once in fifteen million years.

Examples.—The shortest period of all comets is that of Encke's Comet, which returns to the sun every three and one-half years. It swings out beyond the orbit of Mars, but not as far as the orbit of Jupiter. Halley's Comet has a period of nearly seventy-six years. Its last visit was in 1835, and it will come again in 1910. In 1811 a great comet appeared, which, from the shape of its orbit, is not expected to return for 3000 years. Biela's Comet, with a period of six and a half years, was torn to pieces by the sun about fifty years ago, and has not been seen since, but at the time it should appear there is always a shower of meteors which are no doubt fragments of this comet. Donati's Comet of 1858 will not appear again for 2000 years. The great comet of 1861, which swept the earth with its tail, will come again in 400 years. In 1882 a great comet passed between the earth and the sun and was visible in daylight. There are about thirty comets each century that are visible to the natural eye, and about three hundred visible through the telescope.

Meteors.—There are vast numbers of small bodies flying round the sun—too small to be seen through the telescope. Many of them are no larger than ordinary shot. If a ball is thrown into the air filled with dust it strikes many of the dust particles. So the earth in its orbit comes into contact with multitudes of these small bodies, which, when they strike our atmosphere, are soon highly heated by friction and reduced to vapor, the larger ones being readily seen as a streak of white light across the sky. They are often called shooting stars. It is believed that millions of these meteors come into contact with the earth every day, and that but for the friendly mantle of the air, all living beings on the earth would be pelted to death. Sometimes a meteor passes through the air and reaches the earth, when it is called a meteorite. A meteorite is composed chiefly of iron or stone.

Meteoric Showers.—Sometimes there is a much greater fall of meteors than ordinary. The greatest meteoric shower on record occurred in 1833. Whatever may be the origin of ordinary meteors, it is certain that showers of meteors are the fragments of shattered comets. A shower similar to that of 1833 occurred in 1799, and another in 1866. These are called Leonids, because they seem to emanate from the constellation Leo. They are found in the track of a comet whose period is a little over thirty-three years. The earth crosses this path about November 14, of each year and the shower always occurs on or very near that date.

On the tenth of every August, between midnight and sunrise, a considerable number of

meteors may be seen. These are called Perseids, as they seem to radiate from Perseus. They pursue the track of Swift's Comet, whose period is one hundred and twenty years. These small bodies are distributed throughout the entire vast course of that comet, many hundred millions of miles, and every time the earth crosses this path (Aug. 10), some of the Perseids are encountered. When the earth crosses the path of the lost Biela's Comet (especially every sixth year, the period of the comet), meteors are seen. These are called Bielids.

CHAPTER III

THE SIDEREAL HEAVENS

When we go out on a clear, moonless night, and gaze into the deep celestial vault above us, we are struck with awe and wonder at the interminable vastness of the visible universe. And how our awe is increased when we consider that, except perhaps three or four visible planets, every glittering star in the sky is a mighty blazing sun, some of them a thousand times greater than our own sun—that their distances from us and from one another are so stupendous as to baffle all human understanding—that many of them are doubtless the centers of revolving worlds, so far away that the telescope cannot reveal them.

Fixed Stars.—We speak of the stars as "fixed," because year after year they seem to occupy the same place in the sky. It is true they rise and set, as the sun and moon, and, owing to the revolution of the earth around the sun, they gain four minutes every day (and this amounts to twenty-four hours in a year), but in one year from any moment of observation the stars will again occupy the same places precisely. More strictly speaking, however, the stars are not fixed; they are all moving, some with incredible velocity, but so great are their distances from us that their relative positions seem unchanged for thousands of years. Absolute rest is a thing unknown in nature. Nothing seems more fixed to us than the solid

earth. Yet the earth turns on its axis at the rate of a thousand miles an hour, speeds around the sun at nineteen miles a second, and is traveling with the sun through space at the rate of twelve miles per second. So the stars are all, as far as known, performing sublime revolutions through celestial spaces.

Number.—The number of stars visible to the naked eye is about 5000, not more than half of which can be seen at any one time. To see the entire 5000 on any one night one would have to observe from the equator and watch from sunset till sunrise. The number of stars visible through the telescope reaches nearly a hundred million. It is believed further that the dark bodies in the heavens far outnumber the bright ones, but only the latter are visible, even through the telescope.

Size.—The dimensions of some of the twinkling orbs that bespangle the night skies are vast beyond conception. A lofty mountain peak seems to us a gigantic object indeed; but what a speck it is compared with the earth, which weighs six sextillions of tons. But it would take hundreds of thousands of earths to equal the sun, and yet some of the stars which have been measured are thousands of times larger than the sun.

Celestial Distances.—The distance of a star is measured by taking its angular measurement and then repeating it six months later, when the earth has traveled half way round the sun and is 180,000,000 miles from the first point of measurement. Thus a triangle with the star at the apex is formed. One side and two angles are known,

and by a well-known rule of trigonometry the other dimensions may be found. Only approximate results can be obtained.

Of all the astonishing revelations of the heavens, celestial distances are the most astonishing. The human mind is baffled and confounded at an attempt to grasp the appalling space that separates us from the nearest of the stars. Compress the solar system, nearly six billion miles in diameter, into a space one foot in diameter; the sun would be a tiny dot in the center, and the nearest fixed star, on this scale, would be five-sixths of a mile away. How lonely and isolated is our system in space! and perhaps all other systems are equally so.

The nearest of the fixed stars is Alpha Centauri—not visible north of the latitude of Tennessee—and this star is 275,000 times as far from us as we are from the sun, or twenty-five trillions of miles. Other stars have been measured that are more than forty times as far away.

The Light Year.—The unit of celestial measurement is the light year—the distance that light travels in a year. The velocity of light is 186,000 miles per second. It travels around the earth eight times in a second, or four times while a pedestrian is taking a step. Were the sun blotted out of the sky we would discover the fact eight minutes later, as it requires eight minutes for light to travel from the sun to the earth. Light travels to the moon in less than a second and a half, and to Neptune in four and a half hours. The nearest fixed star is four and a third light years from the earth. Some have been found to be nearly two hundred light years from our

system, and it is believed that there are stars whose light has been speeding toward us for thousands of years and has not yet reached us.

Arcturus is one of the finest first magnitude stars in the summer sky. It is mentioned in the Book of Job, and in many ancient writings. It is one of the most distant stars yet measured—one hundred and sixty light years—and it is traveling toward us at the marvelous speed of two hundred miles per second. But no one need fear, for it would take 150,000 years to reach the point where we now are, and long ere then our system will be far away. For an express train, running sixty miles an hour, day and night, to cover the distance between us and the moon would require five and a half months; to reach the sun would take nearly 180 years, while the distance to Arcturus would require eighteen hundred million years.

Nova Persei.—Now and then a star is seen to blaze forth for a few days or weeks and then fade away into invisibility. This may be caused by its contact with a planet or a comet. The most notable recent occurrence of this sort took place in February, 1901. A star called Nova Persei (the new star in the constellation Perseus), hitherto a faint star, blazed out into one of the first magnitude, but after a few days it faded away into a ninth magnitude star. Astronomers have agreed that the light and heat of this great sun must have increased thus suddenly 10,000 fold. Two deeply impressive thoughts here come to mind. First, if this mighty sun was the center of a system of worlds, and these worlds were the homes of living beings, all must have perished

within a few hours. Second, this appalling conflagration actually took place a hundred years ago, for the star is a hundred light years from the earth.

Magnitude.—About twenty of the brightest stars in the sky are known as first magnitude stars, not that they are nearer, but brighter, and probably larger than the average. Some sixty of the next brightest are of the second magnitude, and so on. Stars dimmer than the sixth magnitude are not visible to the naked eye, but the telescope reveals them up to the eighteenth magnitude. The ancients gave fanciful names to many of the brighter stars; but modern astronomers have adopted the Greek alphabet with the genitive of the Latin name of a constellation. Thus Vega, the brightest star in the constellation Lyra, is called Alpha Lyræ, and Riegel, the second brightest in Orion, is called Beta Orionis. We shall, however, use the ancient names in the following study of the constellations in cases where the stars have such names.

The following brief study of the constellations will, it is believed, enable a careful student to trace out the chief ones without further aid, but a planisphere or star-map will be found a great help.

CHAPTER IV

THE CIRCUM-POLAR CONSTELLATIONS

The stars around the north celestial pole never set in our latitude; they simply whirl around the pole once in twenty-four hours. The north pole of the sky is the point that would be reached by the north pole of the earth were it extended on into space. If we were on the equator, the north celestial pole would lie on the northern horizon; if we are 40° north of the equator, it is 40° from the horizon; if we were at the north pole of the earth, the celestial pole would be in the zenith. The following observations assume that the observer is about 40° north of the equator. There is a second magnitude star so near the north celestial pole that we call it the North Star, or Pole Star, though it is one and a half degrees, or three moon widths, from the pole. It should be the first star learned by the observer.

Ursa Minor, the Little Bear, also known as the Little Dipper.—This constellation attracted much attention in ancient times because of the Pole Star. The dimensions of this star are very great and it is forty-seven light years from the earth. It may be found in three ways. 1. It is the end of the handle of the Little Dipper. 2. It is almost in line with the "pointers" of the Great Dipper. 3. It is half way between the middle of the handle of the Great Dipper and Cassiopeia. The handle of this Dipper is curved

and composed of very dim stars, but the two stars at the end of the bowl are brighter. The name of the one at the bottom is *Kochab*.

Ursa Major, the GREAT BEAR, known also as the GREAT DIPPER.—This is a large constellation, but only the seven stars composing the "dipper" are conspicuous, and we confine our notice to them. This figure is too well known to need description. The names of these seven stars beginning with the end of the handle are *Alkaid, Mizar, Alioth, Megrez, Phecda, Merak and Dubhe.* These are all second magnitude except Megrez, which is third magnitude.

Dubhe is twenty-nine degrees from the Polar Star; the top of the dipper is ten degrees in length and the bottom eighteen degrees; the two pointers are 5° apart. These distances should be carefully remembered for future use.

Mythology.*—Calisto was the daughter of Lycaon, King of Arcadia, and was an attendant of the goddess Diana. Jupiter fell in love with the beautiful princess Calisto, and his wife Juno became enraged with jealousy and changed the princess into a bear.

Calisto, however, had borne to Jupiter a son named Arcas, who became a famous hunter. One day while hunting in the Arcadian forest he came upon a bear, and was about to slay it, not know-

* This feature, the mythology of the constellations, has no relation to the modern study of astronomy, and it is therefore omitted from nearly all recent books on the subject. It is here inserted because it adds much interest to the study of the stars, and is constantly referred to in the Greek and Roman classics.

ing that it was his mother. Jupiter then interfered and changed Arcas into a bear also and translated both to heaven. Calisto became Ursa Major andArcas Ursa Minor. When Juno learned of this she was greatly displeased, and she went to Tethys, wife of Oceanus, the Ocean, and begged her to promise never to receive these bears beneath her waves. Tethys promised, and as a result these constellations never set, but whirl forever round the pole.

Draco, the DRAGON.—The following description will answer only in summer. Half way between the two dippers is a row of faint stars, from three to eight degrees apart, curving around the bowl of the Little Dipper 8° to 10° from it, turning to the west and making a coil back toward the south, ending with four stars in an irregular square, forming the head of the dragon. The two southernmost of these four stars are the eyes; they are brighter than any others in the dragon, and are 16° a little west of north from the fine star Vega. The one nearest Vega is *Etanin*, the one further west is *Alwaid*.

Myth.—There are various legends of the Dragon. One is that it was the one that guarded the golden apples in the famous garden of Hesperides at the foot of Mt. Atlas in Africa. It was slain by Hercules and Juno gave it a place in the sky. Another is that this was the Dragon that fought with Minerva in the battle of the giants, and Minerva hurled it into the sky and twisted it round the pole where it remained.

CHAPTER V

THE SUMMER CONSTELLATIONS

NOTE.—The following is adapted to 9 P. M. July the first. The Heavens present the same appearance at 11 P. M. a month earlier, or at 7 P. M. (if it were dark) a month later. The stars are nearly four minutes earlier each day, amounting to two hours a month. This is due to the earth's progress in its orbit.

Bootes.—(pro. Bo-o′ tes) the BEAR DRIVER or HUNTSMAN.—This constellation is marked by the second brightest star in the sky, *Arcturus*, surpassed only by Sirius. Arcturus may be easily found. It is now a little west of the zenith and shines with a reddish lustre. A straight line drawn through Alkaid and Mizar (the two stars at the end of the Great Dipper handle) will fall about 8° east of Arcturus. West of this star are three dim ones forming a triangle, and east of it are three almost in line, while north of it, about ten degrees, are three others almost in line, the middle one being very dim. Still further toward the pole are three stars forming a triangle. No star in the constellation except Arcturus, is brighter than third magnitude.

Of the mythology of Bootes there are various versions; but it is generally agreed that he is a huntsman chasing the two bears around the pole. He holds two dogs by a leash, one of which, Cor Coroli, about 12° southwest of Alkaid, is plainly visible.

Virgo, the VIRGIN. — Southwestward from Arcturus and about half way from that star to the horizon there is a beautiful 1m (first magnitude) star called *Spica*. Northwestward and northeastward from it are scattered a number of small stars —all belonging to the same Constellation Virgo. This is one of the twelve constellations of the zodiac. The student should carefully locate the belt round the heavens called the zodiac and learn the twelve constellations in it called the signs of the zodiac. The sun, moon and all the planets revolve within this belt and never leave it.

Myth.—Some say that this virgin was Isis, the sister of the Egyptian god Osiris, who was basely murdered by Typhon. Isis is following her brother to the grave weeping bitterly. The Egyptians attributed the yearly inundations of the Nile to the profusion of her tears.

Libra, the BALANCE or SCALES.—This is an inconspicuous constellation also belonging to the zodiac. It is east and a little south of Virgo and between that and Corvus, to be noticed later. The virgin is holding the balance in her hand, and the balance indicates that when the sun enters this sign in September the days and nights are equal all over the world.

Corvus, the CROW.—Southwest from Spica near 20° and near the horizon are four stars forming a quadrilateral, wider at the base than at the top. This constellation is called Corvus. Apollo, suspecting the fidelity of his sweetheart, sent a crow to watch her. The bird performed its duty so faithfully that it was given a place in the sky.

Coma Berenices, BERENICE'S HAIR, is a beautiful cluster of small 5m and 6m stars, about a dozen of which are visible to the naked eye on a clear night. The cluster is on the meridian early in May. It is due north from Corvus and about 20° west from Arcturus.

Myth.—Berenice was the wife of Evergetes, King of Egypt, and noted for her wonderful hair. The King on starting out on a dangerous military expedition vowed that if successful he would dedicate his wife's hair to the goddess of beauty. He was successful, and the hair was removed from the queen's head, placed in the temple of Venus, from which it was soon after stolen. The King was very angry, but his astronomer, Conon, appeased him by saying that Jupiter had taken the hair and placed it in the sky, and he pointed out this constellation which has since been known as Berenice's hair.

Corona Borealis, the NORTHERN CROWN.—Southeast from the northern triangle in Bootes there is a beautiful semicircle of stars, the brightest of which is in the middle and is named *Alphacca.* This star is about 12° east from Acturus, and a little north.

Myth.—Ariadne the daughter of Minos, King of Crete was deserted by her husband Theseus and she was so disconsolate that Bacchus took pity on her and gave her a beautiful diadem containing seven stars. This at her death was placed among the constellations.

Hercules.—The scattered stars between Corona Borealis and Vega constitute the constella-

tion Hercules. None is very conspicuous. The southernmost one, in the head of the hero, is called *Ras Algethi*.

Myth.—Hercules was one of the most celebrated of the ancient demigods and was the son of Jupiter and Alcmena. While yet a babe in his cradle but eight months old, the jealous Juno sent two serpents to destroy him, but he strangled them. After he was grown he accomplished many feats of strength. Jupiter bound him to the service of King Eurystheus for twelve years, after which he was to have a place among the gods. This king imposed on him twelve tasks, known as the Twelve Labors of Hercules, the last of which was to bring to earth the three-headed dog Cerebus, which guarded the entrance to Hades. He died at length from wearing a poisoned tunic, given him by his jealous wife, and was translated to the skies. He is pictured with his head toward the south, his foot on the head of the Dragon, with the skin of the Nemaean lion over his shoulder, and the head of Cerebus in his hand.

Ophiuchus and Serpens, the SERPENT BEARER AND THE SERPENT.—These two constellations are usually given as one, and it is difficult to distinguish them as Ophiuchus holds the serpent in his arms. It is a very large constellation, with no very bright stars, situated just south of Hercules and Corona Borealis. The irregular line of stars south of Alphacca in the Crown are the serpent's head. The head of Ophiuchus is northward and is near that of Hercules. One fairly bright star, *Ras Alhague*, marks the head and is but 5° from Ras Algethi.

Myth.—Ophiuchus is said to be Æsculapius, the son of Apollo and the most celebrated physician of antiquity. He is known as the inventor and god of medicine. So great was his skill, that he often raised the dead, and Pluto complained to Jupiter that the lower regions were becoming depopulated. He accompanied the Argonauts on the famous expedition for the golden fleece. Many ancient symbols of this god represent him as an aged man with a long flowing beard and bearing a serpent. So we find him in the constellation.

Scorpio, the SCORPION.—Scorpio is one of the most beautiful and conspicuous of the summer constellations, and it is one of the twelve signs of the zodiac. It lies near the horizon, south of Ophiuchus and Serpens. It contains one fine 1m star, *Antares*, and several 2m stars. Antares is of a reddish color and reminds one of the planet Mars. Westward and a little north from it are several 2m stars, forming an arc of a circle, and with Antares they form the figure of a fan. South and east from Antares there is a curved line of stars, forming the tail of the scorpion. The constellation can easily be found by anyone from the above description.

Myth.—This is the scorpion that Juno sent to sting to death the hero Orion, who had boasted that there was no animal on earth that he could not conquer. This closes the account of what we may call the summer constellations, except the stars lying low on the horizon south of Libra and Virgo. These belong to Centaurus the Centaur, a fabulous monster half man, half horse. This constellation is a very fine one, but only a small portion of it can be seen in the United States. It contains the nearest of the fixed stars Alpha Centauri.

CHAPTER VI

AUTUMN CONSTELLATIONS

October 1, 9 P. M.

Lyra, the LYRE.—The Lyre is just east of Hercules and passes the meridian at 9 P. M., about the middle of August. It is noted for its one beautiful silver 1m star, *Vega*, the reigning monarch of the night sky, since the passing of Arcturus. Vega is twenty-seven light years, or one hundred and fifty-eight trillions of miles from our system. There are but five other stars easily visible in Lyra. Three of them are just east of Vega and form a triangle. The other two are a little further south and also east of Vega, the six forming a figure resembling a lyre. One of these dim stars is a double one and another is variable.

Myth.—This is the lyre of the great musician, Orpheus, presented to him by Apollo. So enchanting was the music of Orpheus that the rivers ceased to flow and the wild beasts and mountains came to listen. The nymph, Eurydice, was charmed by his music; he fell in love with her and they were married. But their happiness was short-lived. A serpent bit her foot and she died. Orpheus then resolved to enter the lower regions to recover his bride. He took his harp with him, and so ravishing was his music that the wheel of Ixion stopped, the stone of Sisyphus stood still, and Tantalus forgot his thirst. Pluto

and his wife Proserpine were so charmed that they promised to restore Eurydice on the condition that Orpheus would not look back while passing out. He agreed, but as he was nearing the regions of the upper air his desire to see his long-lost bride, who was following and whom he had not yet seen, overcame him. He looked back and saw her, but she instantly vanished, and he never saw her again. He wandered aimlessly about the earth until his death, when his Lyre was placed in the sky.

Aquilla, the EAGLE.—This constellation is about 30° southeast of Vega and is noted for its 1m star, *Altair*. This is the brightest star in the Milky Way, and is ninety-four trillions of miles from the earth. It is between two 3m stars, and the three are directly in line with Vega.

Myth.—This is said to be the eagle whose form Jupiter assumed when he carried off Ganymede to replace Hebe as cup-bearer to the gods.

Sagittarius, the ARCHER.—Directly south from Vega and Altair and near the horizon we find the beautiful zodiac constellation Sagittarius. It is directly east from Scorpio. The main part of this constellation is composed of seven bright stars, six of which form two triangles both pointing downward and slightly eastward. These triangles may be imagined as suspended by a cord over the seventh star of the group, a little above and half way between them. A few other stars of this constellation are found northeastward from this group.

Myth.—The stories of the Archer are very conflicting. We give the one accepted by the Greeks.

The Archer is the famous Centaur Chiron, son of Saturn. He was famous for his knowledge of music, medicine, and shooting, and he taught mankind the use of plants and herbs. He was slain by Hercules, according to Ovid, and Jupiter placed him among the stars.

Capricornus, the GOAT.—This constellation of the zodiac is not at all conspicuous. It is east of Sagittarius and somewhat higher. A straight line drawn through Vega and Altair and continued 23° beyond the latter will reach the head of the Goat. By this means it may readily be found. The body of the Goat is composed of the dim stars scattered further toward the east.

Myth.—This was the god Pan, who, with other deities, was feasting on the bank of the Nile when the giant Typhon appeared among them. They all fled and assumed different shapes. Pan became a goat and plunged into the Nile. Jupiter then translated the goat to the skies, and we have the constellation Capricorn.

Delphin, the DOLPHIN.—A very attractive little star cluster is the Dolphin, often called Job's Coffin. It is northeast from Altair, some 13° and is composed of five 3m stars,* four of which form the figure of a diamond.

Myth.—Arion, a famous lyric poet and musician, was a native of Lesbos. He went to Italy and amassed a fortune by his art. When returning by water to his native island the sailors

* This constellation has eighteen stars, but, as in the description of all the others, only those easily found are mentioned.

resolved to murder him for his wealth. He begged them to permit him first to play on his lute. As he played the dolphins, attracted by his music, swarmed about the ship. He then sprung into the sea, and one of these creatures bore him safe to shore on its back—and it was given a place in the sky.

Cygnus, the SWAN.*—This is a very remarkable and beautiful constellation, situated in the Milky Way, directly east of Lyra and north of Delphin. The brightest star, *Deneb*, is 30° directly north of Delphin. The Swan, with widespread wings, is flying down through the Milky Way, the head being almost midway between Vega and Altair. The 3m star in the beak is *Albireo*. Deneb is in the base of the tail which points toward Cassiopeia.

Myth.—Various fables are given of the origin of this constellation. The one mentioned by Virgil and Ovid is that the constellation took its name from a young man named Cygnus, a relative of Phaeton. Cygnus mourned deeply at the untimely death of his relative (see Fluvius Eridanus), and the gods were so pleased that they gave him a place in the sky.

Pegasus, the FLYING HORSE—This is also a very conspicuous constellation, and is noted for its fine square, known as the Great Square of Pegasus. The four stars forming it are from 14° to 16° apart, and the two furthest west are about 40° east of the Dolphin. The square crosses the meridian about Nov. 1, at 9 P. M., and is easily

* Called also the Northern Cross.

found. The names of the four stars are *Markab*, farthest to the southwest; *Sheat*, in the northwest; *Alpherat*, northeast, and *Algenib*, in the southeast. All except Algenib are 2m. Alpherat, however, though necessary to make up the square, belongs not to Pegasus, but to Andromeda, to be noticed later. Pegasus is a large constellation, and includes the stars between the square and the dolphin, one of which, *Enif*, is of the 2m.

Algenib and Alpherat are almost on the line of the equinoctial colure, or prime meridian of the heavens. From this line, which is in Astronomy what the meridian of Greenwich is in Geography, is measured the longitude of the sky, known as right ascension.

Myth.—Pegasus is the fabled horse that sprung from the blood of Medusa after Perseus had cut off her head (see next chapter). The horse was presented by the gods to Prince Bellerophon, to aid him in conquering the Chimera, a hideous monster that vomited flames. After slaying the monster, Bellerophon attempted to fly to heaven on his winged horse, but Jupiter, displeased at his presumption, sent an insect to sting the horse. This so unsettled the rider that he fell back to earth; but the horse continued its flight and was placed among the constellations.

Pisces Australias, the SOUTHERN FISH.—This constellation is interesting only because it contains *Fomalhaut*, a fine 1m star. It is easily found. Draw a line through Sheat and Markab and produce it about two-thirds of the way from the latter to the southern horizon, where it will fall just east of Fomalhaut. This star is in the mouth of

the fish, which receives the stream of water poured from the urn of Aquarius.

Aquarius, the WATER BEARER.—Between Pegasus and Fomalhaut are scattered many dim stars, which the ancient imagination resolved into a man holding an urn and pouring from it a stream of water into the mouth of the Southern Fish.

Myth.—This was the beautiful Phrygian youth, Ganymede, son of the king of Troy. While attending his father's flock on Mt. Ida, Jupiter took him up to heaven to replace Hebe as cup-bearer to the gods—hence he is pictured with an urn.

CHAPTER VII

WINTER CONSTELLATIONS

January 1, 9 P. M.

Cepheus.—This constellation belongs by location to the last chapter; or, like Cassiopeia, it may have properly been placed with the circumpolar constellations. But I have reserved it for this place because it belongs to a remarkable group, a royal family, that I wish to notice together.

Cepheus is not a bright constellation and not so readily found by amateurs as many others. If a straight line be drawn from the Pole Star half way between Cygnus and Pegasus it will pass through Cepheus, which is about half as far from the pole as is Cygnus. There are three 3m stars, the one furthest south being *Alderamin.* The mythology will be given under Perseus.

Cassiopia, the QUEEN IN HER CHAIR.—This is one of the most attractive of the constellations. It is the same distance from the Pole Star as the Great Dipper, and is directly opposite to it, and, like Cepheus, it never sets. There are five 2m and 3m stars in the form of a wide W, and supposed to resemble a chair. The star furthest west is called *Caph;* it is in line with Alpherat and Algenib—on the prime meridian—and these three form a straight line with Polaris. The name of the star next to Caph is *Schedar.* It will be

noticed that Cepheus is enclosed by Cygnus, Ursa Minor, and Cassiopeia, and is about the same distance from each.

Andromeda, the CHAINED LADY.—This constellation is just south from Cassiopeia. It consists of many stars, only a few of which are conspicuous. As we have noticed, one star of Andromeda, Alpherat, belongs to the Great Square of Pegasus. The chief remaining stars of this constellation may readily be found by drawing a line diagonally across the square from Markab through Alpherat. Continue the line east 7° from Alpherat to a 3m star, and on the same line 7° still further is *Merach*, a 2m star, which, with a few dim ones above and below it, form the girdle of the Princess. Continue the line 10° or more to another 2m star, *Almach*, the last important star in Andromeda.

Perseus.—If we continue the slightly curved line on which we found all the principal stars of Andromeda, some 12° east beyond Almach, we reach *Mirfak*, the brightest star in Perseus.

Perseus is east of Andromeda and directly north of the Pleiades. It contains many fine stars, one other, *Algol*, being 2m. Algol is one of the most wonderful stars in the sky. For about two and one-half days it is a 2m star when its light slowly fades for three and a half hours until it is a 4m star, but after three and a half hours more it regains its original brightness. This was noticed by the ancient Arabs, as the name they gave it shows. Algol means demon. For many ages the cause of the variation was unknown. But it is now known that Algol has a dark companion

around which it revolves, and which hides part of its light at each revolution. Algol may easily be located. A line drawn to it from Mirfak and another from Almack, forms a right triangle at Algol, which opens directly toward Cassiopeia. Algol has a small star very near it and nearly south of it, by which it may also be known. The other conspicuous stars of Perseus are scattered on each side of Mirfak, forming an irregular line toward Cassiopeia.

Myth.—The mythological stories of the four above-named constellations are inseparable. Cepheus was King of Ethiopia; Cassiopeia was his wife and Queen, and Andromeda was their daughter. Cassiopeia was a queen of matchless beauty, and she boasted that she was more beautiful than Juno and the sea nymphs, or Nerides. Juno and the nymphs were highly insulted and they complained to Neptune, and he sent a frightful monster to ravage the coast of Ethiopia. Cepheus and his Queen consulted the oracles and were informed that nothing short of the sacrifice of their daughter Andromeda to the jaws of the sea-monster would appease the wrath that had been awakened. Andromeda was therefore chained to a rock to await her doom when Perseus with his feet-wings came flying through the air.

Perseus, the son of Jupiter and Danae, was cast as soon as born into the sea with his mother. They were rescued by a fisherman and carried to the king of one of the islands of the Cyclades where Perseus grew to manhood. At a feast of the King Perseus engaged to bring him the head of Medusa, one of the three Gorgons, which had power to turn to stone anything they looked upon.

Mercury lent him wings for his feet, and a dagger. He found the gorgons sleeping, cut off the head of Medusa, and fled with it bleeding through the air. When he came upon the princess Andromeda, chained to a rock, he fell in love with her and proposed to her father that he would save her from the monster, if she might marry him. Cepheus promised and Perseus turned the eye of the reeking head upon the monster and changed it to stone. The nuptials were soon celebrated and the royal family lived happily. All of the four were translated to the sky after death. Perseus in the constellation still holds the head of Medusa, and the eye with which he destroyed the sea-monster is the blinking star, Algol.

Aries the RAM.—Aries is 19° almost directly south of Almack in Andromeda; but between the two are three dim stars known as Triangula, forming a long slim triangle.

Aries is the first sign in the zodiac. It will be noticed that the zodiac is now mounting higher toward the zenith, as the sun in summer is much higher in the heavens than in winter. But it should be remembered that the zodiacal constellations viewed in winter are high as they are opposite the sun in the heavens, and those viewed in summer are low.

There are but two bright stars in Aries, but 5° apart. The one further east is *Hamal* and the other *Sheratan*. Just south of Sheratan and very near it is a dim star.

Myth.—This is the ram, according to fable, that bore the golden fleece to recover which the world-famous Argonautic Expedition was under-

taken by Jason, and his companions. On this ram Phryxus and his sister Helle were borne through the air to escape their cruel step-mother Ino. Helle became dizzy and fell into the strait, which was ever after called the Hellespont.

Pisces, the FISHES.—This zodiac constellation occupies a large space between Aries and Aquarius, but contains no bright stars. But there is one very attractive feature. Immediately south of the Great Square of Pegasus there are seven 5m stars forming almost a perfect circle or polygon. This can be seen only when the night is clear and moonless.

There are two fishes in the constellation; the Northern Fish, south of Andromeda, and the Western Fish, south of Pegasus.

Myth.—When the hundred-headed giant Typhon put the gods to flight on the banks of the Nile, they assumed different shapes for the time to escape his fury. Venus and her son Cupid became fishes—and two fishes were accordingly placed among the constellations.

Cetus, the WHALE.—As the whale is the largest of living creatures, Cetus covers a greater space than any other constellation. But it contains few bright stars. It lies south of Aries and Pisces. A 2m star called *Menkar* is 37° directly south of Algol. Menkar also forms an equilateral triangle with the Pleiades and Hamal. Note further that this star with four lesser ones forms a small pentagon. This is in the nose of the whale. The body extends westward and includes many stars south of Pisces. One of these is very re-

markable and is known as *Mira Ceti*, the wonderful star of the Whale. For three months it is a 2m star, when it gradually fades away and cannot be seen with the naked eye for eight months. Then it comes back again and so continues in periods of eleven months. Mira is directly south of Hamal in Aries, and when on the meridian is exactly between the horizon and the zenith.

Myth.—Most ancient writers consider this the sea-monster that was sent to destroy Andromeda and was slain by Perseus. It was placed among the stars to commemorate the valor of Perseus.

Auriga, the CHARIOTEER.—This constellation is east of Perseus and a little further from the pole. It is noted for its one brilliant 1m star *Capella*, 24° east of Algol. The constellation is supposed to represent the figure of a man with a goat in his left hand and a bridle in his right. Capella is in the goat near the left shoulder and a 2m star, formerly called *Menkalinan* 7° east of it is in the right shoulder. South of Capella 18° is a 2m star named *Nath* and forms with it and Menkalinan a long triangle.

Myth.—One version of this constellation is that Auriga is Erichthonius, King of Athens. He was the inventor of chariots and had great power in managing horses. For these excellences he was translated to the skies.

Taurus, the BULL.—This constellation is directly south of Perseus and Auriga and is remarkable for two well-know star clusters—the *Hyades* and the *Pleiades*.

The Hyades is in the shape of the letter V and the end star of one side is the 1m star *Aldebaran.*

The Pleiades or seven stars are a beautiful cluster 11° northwest from Aldebaran. They cross the meridian at precisely 9 P. M. on Jan. 1.

Myth.—Europa was the daughter of Angenor and princess of Phœnicia. She was rarely beautiful and Jupiter, becoming enamored of her, assumed the form of a snow-white bull and approached her as she was gathering flowers. She caressed the beautiful animal and was encouraged to mount his back. The bull then rushed to the sea, plunged in, and carried Europa to Crete, and from her Europe took its name. The bull was afterward placed among the constellations.

The Pleiades were seven sisters, daughters of Atlas and the nymph Pleione. One day, when strolling through the forest, the huntsman Orion came upon them and was so attracted by their beauty that he pursued them. They fled; Orion was about to overtake them when Jupiter changed them to doves and took them to heaven. The fact that there are but six visible has two explanations. One is that one of them, *Merone*, married a mortal and her light was put out for the act. Another is that one of them, *Electra*, was so grieved at the fall of Troy that never could she bear again to be seen by human eyes. In the midst of the group there is one sister brighter than the rest. Her name is *Alcyone.* The telescope reveals 200 stars in this cluster.

Orion, the HUNTER.—This is the finest and most brilliant constellation in the sky, and the only one in the north containing two 1m stars.

There is a well-defined quadrilateral. The 1m star farthest to the northeast is *Betelgeux*, and its companion, 2m, some 7° west of it, is *Bellatrix*. These are in the shoulders. The other two are 15° south of these. *Rigel*, a 1m star, is farthest southwest. In the center are three remarkable stars in line, very near together, forming the belt, while suspended from it is the sword, composed of a dim line of stars pointing downward. In front of the hero, who faces the Bull in a menacing attitude, and almost south of Aldebaran, is a semi-circle of dim stars forming the lion-skin shield.

Myth.—Orion, the son of Neptune, was the greatest hunter in the world. He boasted that he could conquer any animal, whereupon a scorpion rose from the earth and stung him to death; and he still seems to fear that creature, for this constellation sets at the rising of Scorpion. The constellation Orion is mentioned in the books of Job and Amos, and in the writings of Homer and Virgil.

Fluvius Eridanus, the River Po.—The few stars immediately south of Orion belong to Lepus, the Hare; and those south of Lepus lying along the horizon belong to Colomba, Noah's Dove. The River Po is composed of the scattered stars lying south of Taurus and Cetus, but is scarcely desirable to trace it out.

Myth.—The Po River was made memorable in many ways, and especially through its connection with the fable of Phaeton. This youth was the son of Phœbus, who had control of the sun in

his daily revolutions. Phaeton begged his father to permit him to guide the sun's chariot for one day. The request was granted, but no sooner had the youth taken the reins than the sun departed from his track, and the heat became so great as to threaten a vast conflagration of heaven and earth. Jupiter, seeing the disorder, struck Phaeton dead with a thunderbolt, and he fell from heaven into the Po. The great heat produced on this occasion is said to have dried up the blood of the Ethiopians and turned their skins black. The fable probably arose from some extraordinary term of heat in remote antiquity, and this tradition of it alone has reached us.

CHAPTER VIII

SPRING CONSTELLATIONS

April 1, 9 P. M.

Canis Major, the GREAT DOG.—This is southeast from Orion about 30°, and is famous for its great star, *Sirius*, by far the brightest in the heavens. Sirius is probably two hundred times as large as our sun and is fifty trillions of miles from us—so far that at cannon-ball speed the distance could be covered only in five million years. A line drawn from Sirius through the belt of Orion and produced to the Pleiades, is almost a straight line, and falls just west of Aldebaran. The ancients believed that Sirius caused the excessive heat of summer, and the days of his reign were called Dog Days. At this season the star is not visible because it is overhead in daytime. The Egyptians noticed that the overflow of the Nile was always presaged by the rising of Sirius, which, like a faithful watch-dog, warned them of the inundation. The stars lying near this one belong also to this constellation.

Canis Minor, the LITTLE DOG.—Northeast from Sirius 26°, and forming with it and Betelgeux a perfect equilateral triangle, is another 1m star called *Procyon*. It is the chief star in the Little Dog, and is diagonally across the Milky Way from the Greater Dog.

Myth —Canis Major and Canis Minor are supposed to be the two hounds of the mighty hunter Orion. The dim stars lying between the two dogs belong to Monoceros, the Unicorn.

Gemini, the TWINS.—About 20° north of *Procyon* are two bright stars near together. They are the famous twins of ancient mythology, Castor and Pollux. Pollux is the further south and is rated a 1m star, while Castor is 2m; though it is difficult to distinguish between them, and Castor was formerly the brighter. These two stars are in the heads of the twins, who are in a sitting posture—and their feet are toward Orion. The various stars scattered in that direction form the bodies and feet.

This is the highest constellation in the zodiac. The sun enters it on the 21st of June, when it is of course invisible. Six months later it is on the meridian at midnight.

Myth.—Castor and Pollux were the twin sons of Jupiter and Leda, Queen of Sparta. They accompanied the Argonauts in quest of the golden fleece, and won the admiration of all by their prowess. Castor excelled as a trainer of horses, and his brother for his bravery with arms. The Roman armies often persuaded themselves to believe that in the midst of battle these two gods often appeared to give them victory. The twins were also the protectors of navigation. St. Paul sailed in a ship whose sign was Castor and Pollux (Acts 28: 11). The ancients often swore by the twins, and the expression "By Gemini" is sometimes heard to this day.

Argo Navis, the SHIP ARGO.—Southeast

from Canis Major are several stars of this constellation scattered along the horizon, but the finest ones in it are not visible in the United States. South of Sirius 36° is Canopus, a fine star of the 1m.

Myth.—This is the famous ship in which Jason and his fifty-four companions, called Argonauts, from the name of the ship, sailed to Colchis in quest of the golden fleece. Some suppose, however, that the famous expedition never occurred, and that the story was founded on traditions of Noah and the flood.

Hydra and Crater, the WATER SERPENT and the CUP.—Between Argo Navis on the west and Corvus on the east is an irregular line of stars higher above the horizon than Argo. This is the Water Serpent. Its head, composed of four stars, forming a rhomboid, exactly as far from the horizon as Procyon and about 20° east of it. The cup is much further east, the same height as Corvus and about 22° west of it. It contains six stars, forming a crescent opening to the west. The body of the serpent lies beneath the cup and extends on eastward.

Myth.—This Hydra was the hundred-headed monster that infested the region of Lake Lerna. It was destroyed by Hercules, as one of his twelve labors, and Juno, ever jealous of the fame of that hero, gave the serpent a place among the stars.

Cancer, the CRAB.—This is a very inconspicuous constellation of the zodiac just east of Gemini, and west of Leo. Neither as a constellation nor in its mythology does it present anything very interesting.

Leo, the LION.—This large and attractive constellation of the zodiac lies between Cancer and Virgo. It contains one 1m star, *Regulus*, which with five others further north arranged in a semicircle, form the Sickle, the most conspicuous object in the constellation. There are two or three bright stars northeastward from Regulus, and one 2m star 25° east of it named *Denebola*. Denebola forms an almost equilateral triangle with Spica and Arcturus. This brings us entirely round the heavens, whence we began with the summer constellations.

Myth.—This is the Nemean Lion slain by Hercules. So says the Greek fable, but the Egyptian charts placed a lion in this part of the sky long before the birth of the fabled Hercules. No modern imagination, however, can trace the form of a lion in the constellation.

L. of C.

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